PP&L Montana, LLC
Colstrip Steam Electric Station
P.O. Box 38
Colstrip, MT 59323
Tel. 406.748.5055 Fax 406.748.5000

PP&L MONTANA

January 24, 2000

Mr. William Grimly / Ms. Lara Autry
Emissions Measurement Center (MD-19)
U.S. Environmental Protection Agency
Research Triangle Park, N.C. 27711

Dear Mr. Grimly and Ms. Autry:

Enclosed are two copies of the source emissions test report for the recently conducted mercury speciation tests on Colstrip Unit 3. These tests were performed in response to the U.S. Environmental Protection Agency's Mercury Information Collection Request for electric utilities. Mercury speciation stack testing at PP&L Montana, Colstrip Steam Electric Station (formerly known as Montana Power Company, Colstrip Project Division) Unit 3 was conducted on September 29 and 30, 1999.

Submittal of this test report fulfils PP&L Montana's mercury source testing obligations.

Please contact me at (406) 748-5019 if you have any questions or additional information requirements.

Very truly yours,

Stephen J. Christian
Sr. Environmental Engineer
CEMS/DAHS Administrator

cc: Eric Kopczynski – MDEQ, Billings
Jim Parker – PPLM Colstrip
Letter only:
Betsy Wahl – Region 8 EPA, Helena
Pete Simonich/Tom Olson/Ed Bukoskey/Gordon Criswell – PPLM Colstrip
Carlton Grimm – PPLM Corette

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METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
MONTANA POWER COMPANY
COLSTRIP PROJECT DIVISION
UNIT NUMBER 3-6 SCRUBBER INLET DUCT
AND
UNIT NUMBER 3 STACK
COLSTRIP, MONTANA

SEPTEMBER 1999

FILE NUMBER 99-166

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1 INTRODUCTION

1.1 Summary of Test Program

METCO Environmental, Dallas, Texas, conducted a source emissions survey of Montana Power Company, Colstrip Project Division, located in Colstrip, Montana, on September 28, 29, and 30, 1999. The purpose of these tests was to meet the requirements of the EPA Mercury Information Request. Speciated mercury concentrations at the Unit Number 3-6 Scrubber Inlet Duct, speciated mercury emissions at the Unit Number 3 Stack, and mercury and chlorine content of the fuel were determined. The sulfur, ash, and Btu content of the fuel were also determined.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, 17, and 19; in the Ontario Hydro Method, Revised July 7, 1999; and ASTM Methods D2234, D6414-99, D2361-95, D-0516, D-3174, and D-3286.

1.2 Key personnel

Mr. Bill Hefley of METCO Environmental was the onsite project manager. Mr. Shane Lee, Mr. Mike Bass, Mr. Jason Conway, Mr. Scott Hart, and Mr. Jason Brown of METCO Environmental performed the testing.

Mr. Stephen J. Christian of Montana Power Company acted as the utility representative. Mr. Mike Cadwell of Montana Power Company performed process monitoring and sampling.

Table 1-1
Test Program Organization

Organization	Individual	Responsibility	Phone Number
Project Management and Oversight			
METCO	Bill Mullins	Project Director	(972) 931-7127
Project Team			
METCO	Bill Hefley	Project Manager	(972) 931-7127
Utility			
Montana Power Company	Stephen J. Christian	Utility Representative	(406) 748-5019
Montana Power Company	Mike Cadwell	Process Monitoring	(406) 748-5019
QA/QC			
METCO	Jim Monfries	Quality Assurance Manager	(972) 931-7127

2 SOURCE AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

Colstrip Unit Number 3 is an 810 gross megawatt unit with a steam generator designed and manufactured by Combustion Engineering, and put into commercial operation in 1984. It is a double drum, forced circulation type unit with a balanced draft furnace, and includes a superheater, reheater, economizer, air preheaters, superheater and reheater desuperheaters, coal nozzles, air nozzles and a soot blowing system.

The boiler has a dual furnace that is rectangular and separated by a division wall. Each furnace has two air plenums, and each plenum supplies secondary air to two windboxes mounted vertically and located on the corners of the furnace. The windboxes supply secondary air to the 8 burner assemblies located on the corners of the front and rear walls of each furnace. The burner assemblies are arranged for tangential firing, and they consist of 8 coal nozzles, 14 secondary air nozzles, 2 overfire air nozzles, 6 igniters, 1 warm up gun and flame scanners.

2.2 Control Equipment Description

Colstrip Unit Number 3 is equipped with 8 stainless steel scrubber vessels. Each scrubber vessel consists of 5 main sections: the venturi spray, absorption spray, wash tray, mist eliminator, and recycle tank sections. Most of the fly ash and some sulfur dioxide is removed from the flue gas in the venturi section. The absorption sprays remove additional sulfur dioxide. The wash trays and mist eliminators remove liquid entrainment. High calcium lime is added to maintain proper pH.

The stainless steel scrubber recycle tanks, manufactured by Union Boiler, are 35 feet in diameter, 17 feet high and have a capacity of 100,000 gallons each. The Colstrip Unit Number 3 scrubber system is also equipped with a reheating system containing 8 total reheaters, 1 per scrubber vessel.

Reheaters are provided as the flue gas leaves each scrubber vessel to prevent condensation in the ductwork, induced draft fans, and stack. Induced draft fans are provided to draw flue gas from the boiler and to maintain a slight negative pressure in the boiler. The induced draft fans are centrifugal, airfoil type fans manufactured by Westinghouse with a discharge capacity of 566,252 cfm at discharge pressure of 55.56 inches of water column.

2.3 Flue Gas and Process Sampling Locations

2.3.1 Inlet Sampling Location

The sampling location on the Unit Number 3-6 Scrubber Inlet Duct is 110 feet above the ground. The sampling locations are located 53 feet (4.24 duct diameters) downstream from a bend in the duct and 16 feet 3 inches (1.30 duct diameters) upstream from a bend in the duct.

2.3.2 Stack Sampling Location

The sampling location on the Unit Number 3 Stack is approximately 379 feet above the ground. The sampling locations are located 200 feet (8.33 stack diameters) downstream from the inlet to the stack and 313 feet (13.04 stack diameters) upstream from the outlet to the stack.

2.3.3 *Coal Sampling Location*

The coal sampling locations are located at the coal feeders immediately downstream of the coal pulverizers (P).

Figure 2-1
Description of sampling locations at Colstrip Unit Number 3-6 Scrubber Inlet Duct

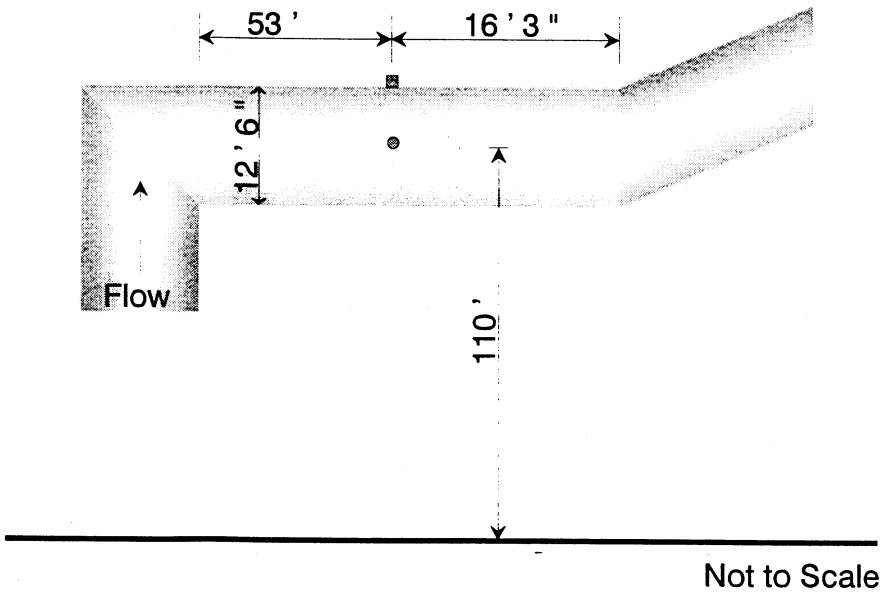
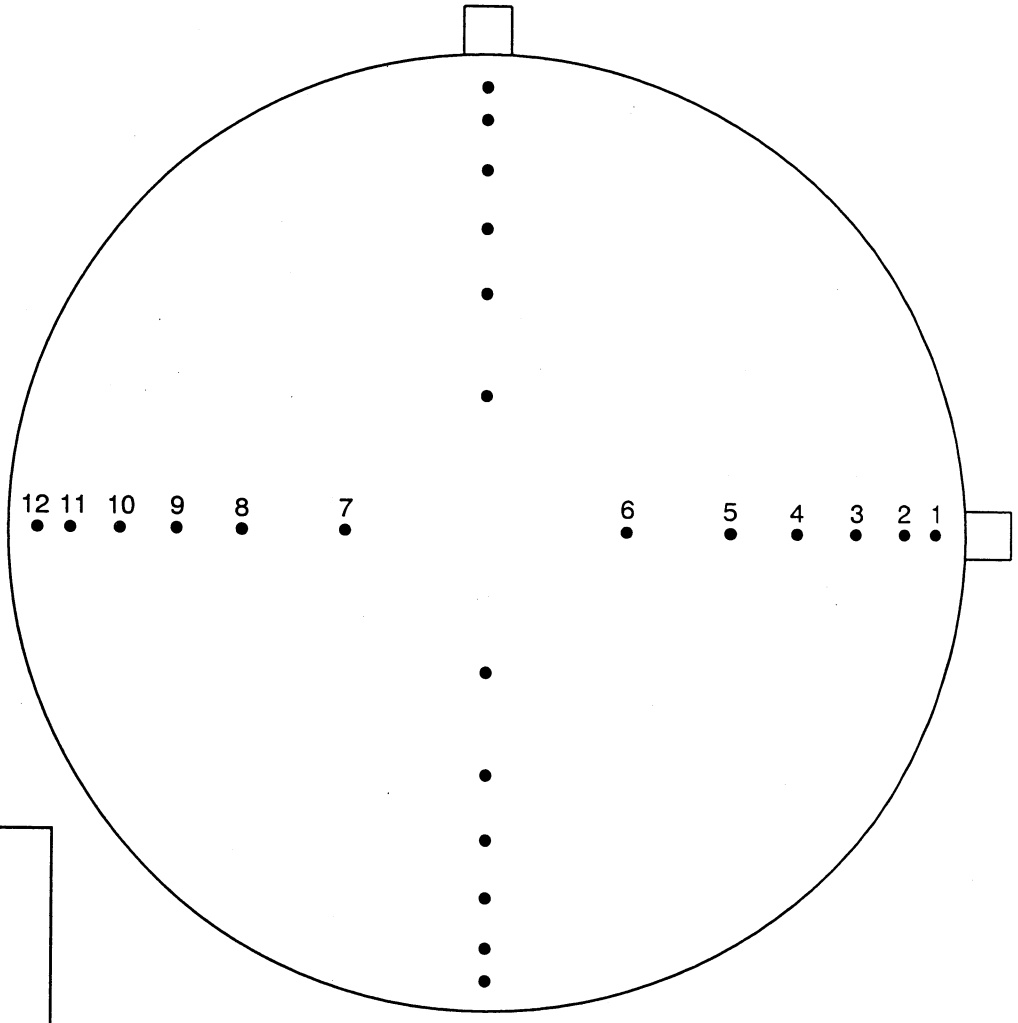


Figure 2-2
Description of sampling points at Colstrip Unit Number 3-6 Scrubber Inlet Duct



Point	Distance from Wall
1	3 1/8 "
2	10 1/16 "
3	17 11/16 "
4	26 9/16 "
5	37 1/2 "
6	53 3/8 "
7	96 5/8 "
8	112 1/2 "
9	123 7/16 "
10	132 5/16 "
11	139 15/16 "
12	146 7/8 "

Figure 2-3
Description of sampling locations at Colstrip Unit Number 3 Stack

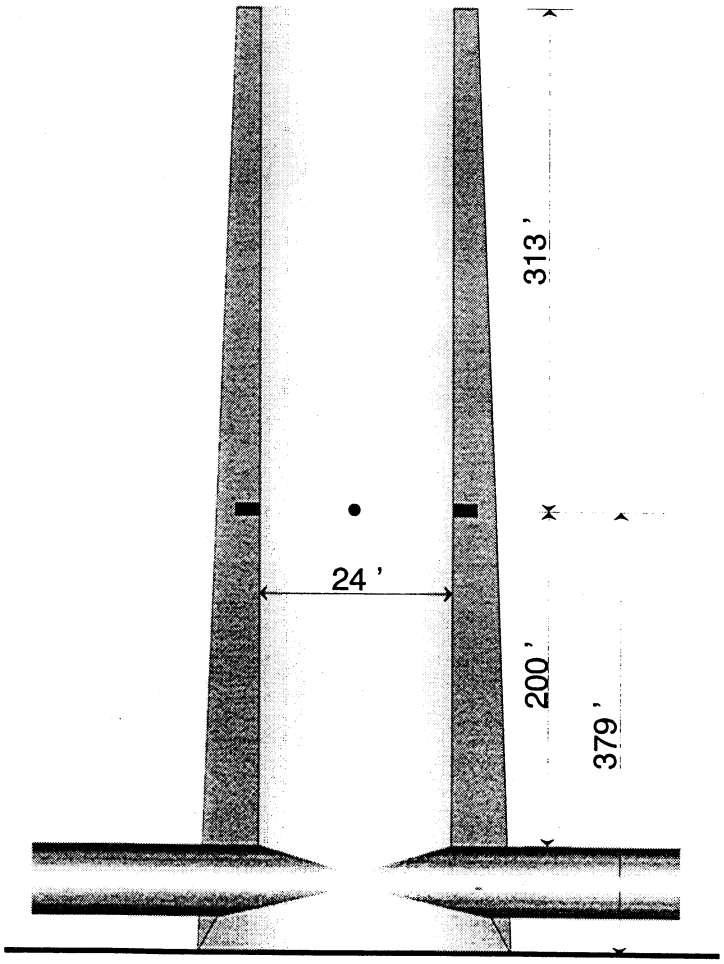
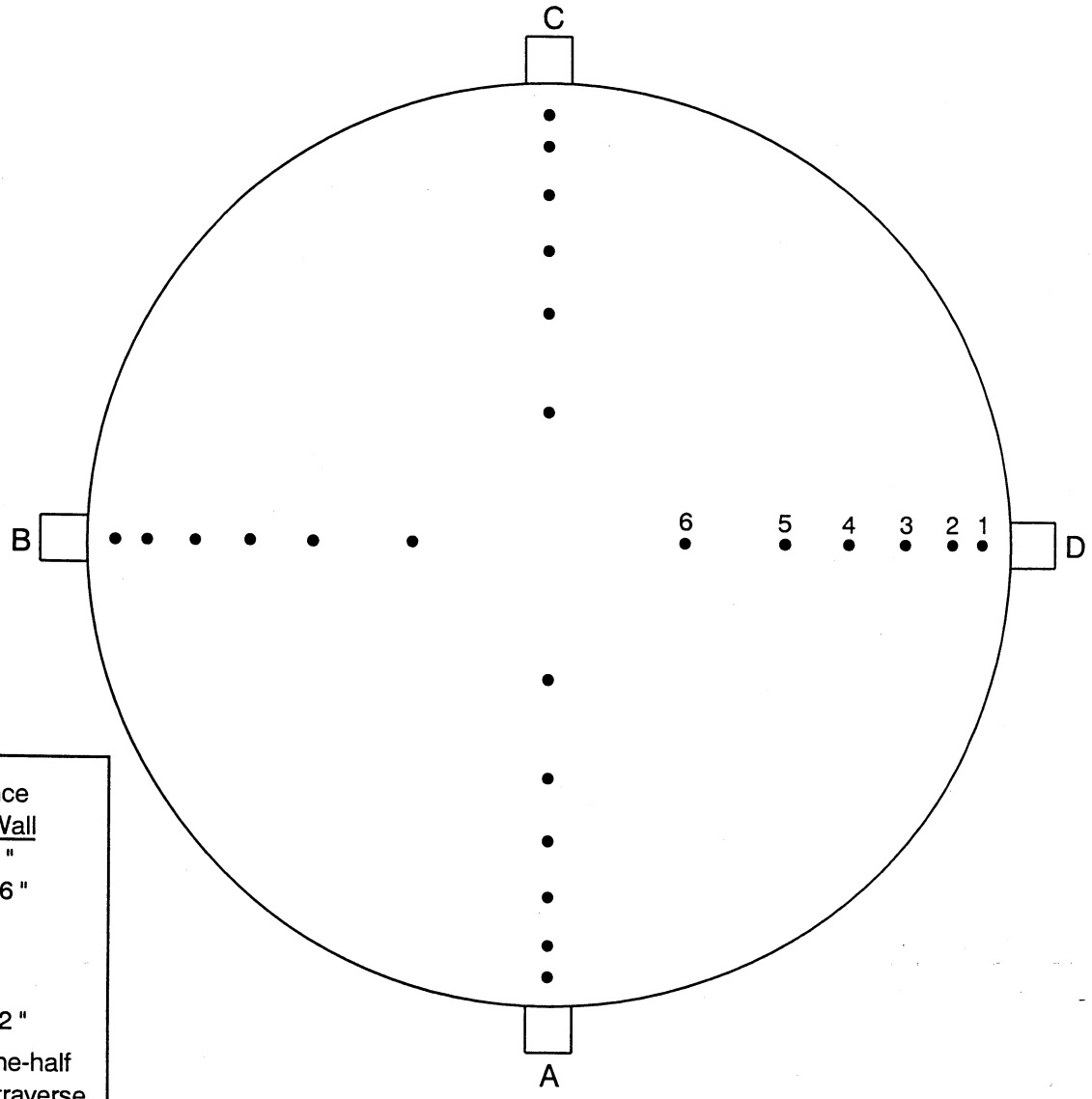


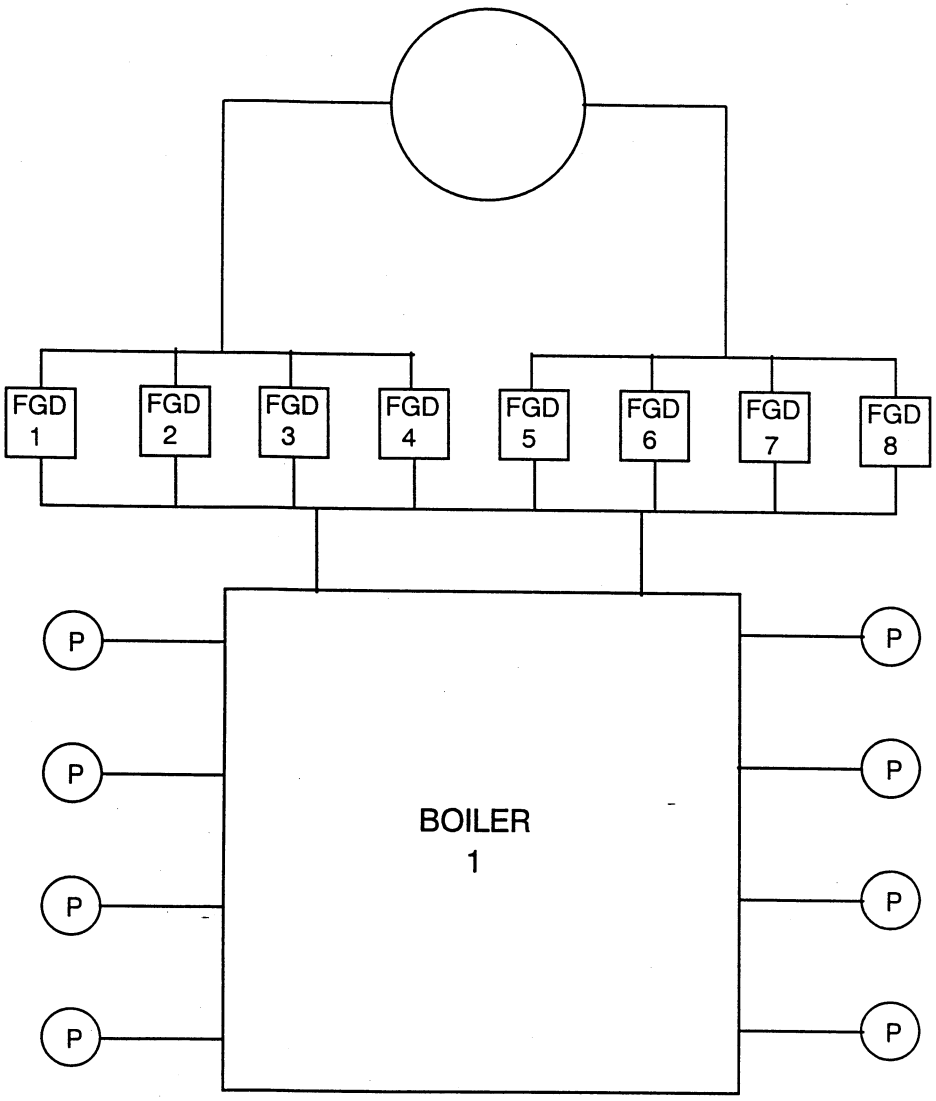
Figure 2-4
Description of sampling points at Colstrip Unit Number 3 Stack



Point*	Distance from Wall
1	6 1/16 "
2	19 5/16 "
3	34 "
4	51 "
5	72 "
6	102 1/2 "

*Calculated as one-half of a twelve point traverse.

Figure 2-5
Description of coal sampling locations at Colstrip Unit Number 3



3 SUMMARY AND DISCUSSION OF RESULTS

3.1 Objectives and Test Matrix

3.1.1 Objective

The objective of the tests was to collect the information and measurements required by the EPA Mercury ICR. Specific objectives listed in order of priority are:

1. Quantify speciated mercury emissions at the stack.
2. Quantify speciated mercury concentrations in the flue gas at the inlet.
3. Quantify fuel mercury and chlorine content during the stack and inlet tests.
4. Provide the above information for use in developing boiler, fuel, and specific control device mercury emission factors.

3.1.2 Test Matrix

The test matrix is presented in Table 1. The table includes a list of test methods to be used. In addition to speciated mercury, the flue gas measurements include moisture, flue gas flow rates, carbon dioxide, and oxygen.

Table 3-1
Test Matrix for Mercury ICR Tests at Colstrip Unit Number 3

Sampling Location	No. of Runs	Species Measured	Sampling Method	Sample Run Time	Analytical Method	Analytical Laboratory
Stack	3	Speciated Hg	Ontario Hydro	120 min	Ontario Hydro	TestAmerica
Stack	3	Moisture	EPA 4	Concurrent	Gravimetric	METCO
Stack	3	Flue Gas Flow	EPA 1 & 2	Concurrent	Pitot Traverse	METCO
Stack	3	O_2 & CO_2	EPA 3B	Concurrent	Orsat	METCO
Inlet	3	Speciated Hg	Ontario Hydro	120 min	Ontario Hydro	Test America
Inlet	3	Moisture	EPA 4	Concurrent	Gravimetric	METCO
Inlet	3	Flue Gas Flow	EPA 1 & 2	Concurrent	Pitot Traverse	METCO
Inlet	3	O_2 & CO_2	EPA 3B	Concurrent	Orsat	METCO
Coal Feeders	3	Hg, Cl, Sulfur, Ash, and Btu/lb in coal	ASTM D2234	1 grab sample every 30-minutes per mill per run	ASTM D6414-99 (Hg), ASTM D2361-95 (Cl), ASTM D-0516 (S), ASTM D-3174 (Ash), and ASTM D-3286 (Btu/lb)	TestAmerica and Philip Services

3.2 Field Test Changes and Problems

No deviations were made from the approved Sampling and Analytical Test Plan.

3.3 Summary of Results

The results of the tests performed at Colstrip Unit Number 3 are listed in the following tables.

Table 3-2
Colstrip Unit Number 3 Source Emissions Results

Run Number	1	2	3
Test Date	09/29/99	09/29/99	09/30/99
Test Time	0830-1220	1330-1603	0815-1049
Inlet Gas Properties (Scrubber 3-6)			
Flow Rate – ACFM	467,463	473,326	474,406
Flow Rate – DSCFM*	247,416	249,536	253,186
% Water Vapor - % Vol.	9.58	9.54	10.71
CO_2 - %	14.8	14.6	14.4
O_2 - %	4.6	4.6	4.8
% Excess Air @ Sampling Point	27	27	29
Temperature - °F	284	287	277
Pressure – "Hg	24.59	24.58	24.87
Percent Isokinetic	99.6	99.9	101.7
Volume Dry Gas Sampled – DSCF*	52.381	52.964	54.722
Stack Gas Properties			
Flow Rate – ACFM	3,131,017	3,124,268	3,109,234
Flow Rate – DSCFM*	1,849,974	1,839,184	1,858,277
% Water Vapor - % Vol.	15.60	15.91	15.61
CO_2 - %	13.6	13.4	13.2
O_2 - %	6.2	6.2	6.2
% Excess Air @ Sampling Point	41	41	41
Temperature - °F	193	193	193
Pressure – "Hg	25.81	25.81	26.11
Percent Isokinetic	93.3	95.4	101.9
Volume Dry Gas Sampled – DSCF*	76.204	77.441	83.600

* 29.92 "Hg, 68 °F (760 mm Hg, 20 °C)

Table 3-3
Colstrip Unit Number 3 Mercury Removal Efficiency

Run Number	1	2	3	Average
Test Date	09/29/99	09/29/99	09/30/99	
Test Time	0830-1220	1330-1603	0815-1049	
Total mercury				
Inlet - lb/10^{12} Btu	3.67	7.62	7.05	6.11
Stack - lb/10^{12} Btu	6.55	7.90	1.54	5.33
Removal efficiency - %	-----	-----	78.2	12.8
Particulate mercury				
Inlet - lb/10^{12} Btu	1.27	1.39	1.16	1.27
Stack - lb/10^{12} Btu	0.04	0.02	0.01	0.02
Removal efficiency - %	96.8	98.6	99.1	98.1
Oxidized mercury				
Inlet - lb/10^{12} Btu	1.64	1.69	2.04	1.79
Stack - lb/10^{12} Btu	N.D.	N.D.	N.D.	N.D.
Removal efficiency - %	100.0	100.0	100.0	100.0
Elemental mercury				
Inlet - lb/10^{12} Btu	0.77	4.54	3.85	3.05
Stack - lb/10^{12} Btu	6.52	7.88	1.52	5.31
Removal efficiency - %	-----	-----	60.5	-----

N.D. – None Detected.

Table 3-4
Colstrip Unit Number 3 Mercury Speciation Results

Run Number	1	2	3	Average
Test Date	09/29/99	09/29/99	09/30/99	
Test Time	0830-1220	1330-1603	0815-1049	
Inlet Mercury Speciation (Scrubber 3-6)				
Particulate mercury – ug	2.41	2.66	2.28	—
ug/dscm	1.62	1.77	1.47	1.62
lb/10^{12} Btu	1.27	1.39	1.16	1.27
% of total Hg	34.6	18.2	16.5	23.1
Oxidized mercury – ug	3.10	3.24	3.98	—
ug/dscm	2.09	2.16	2.57	2.27
lb/10^{12} Btu	1.64	1.69	2.04	1.79
% of total Hg	44.7	22.2	28.9	31.9
Elemental mercury - ug	1.45	8.70	7.52	—
ug/dscm	0.98	5.80	4.85	3.88
lb/10^{12} Btu	0.77	4.54	3.85	3.05
% of total Hg	21.0	59.6	54.6	45.1
Total mercury – ug	6.96	14.60	13.78	—
ug/dscm	4.69	9.73	8.89	7.77
lb/10^{12} Btu	3.67	7.62	7.05	6.11
Stack Mercury Speciation				
Particulate mercury – ug	0.090	0.050	0.040	—
ug/dscm	0.04	0.02	0.02	0.03
lb/10^{12} Btu	0.04	0.02	0.01	0.02
% of total Hg	0.6	0.3	0.6	0.5
Oxidized mercury – ug	N.D.	N.D.	N.D.	N.D.
ug/dscm	N.D.	N.D.	N.D.	N.D.
lb/10^{12} Btu	N.D.	N.D.	N.D.	N.D.
% of total Hg	0.0	0.0	0.0	0.0
Elemental mercury – ug	16.20	19.90	4.15	—
ug/dscm	7.51	9.07	1.75	6.11
lb/10^{12} Btu	6.52	7.88	1.52	5.31
% of total Hg	99.4	99.7	98.7	99.3
Total mercury – ug	16.29	19.95	4.19	—
ug/dscm	7.55	9.10	1.77	6.14
lb/10^{12} Btu	6.55	7.90	1.54	5.33
Coal Analysis				
Mercury - ppm dry	0.063	0.066	0.067	0.065
Mercury - lb/10^{12} Btu	6.58	7.12	7.06	6.92
Chlorine - ppm dry	<100	<100	100	<100
Moisture - %	11.4	12.0	11.4	11.6
Sulfur - % dry	0.72	0.74	0.76	0.74
Ash - % dry	16.8	18.0	17.3	17.4
HHV - Btu/lb as fired	9,550	9,300	9,470	9,440
Coal flow - lb/hr as fired	923,000	936,000	912,000	923,667
Total Heat Input – 10^{6} Btu/hr	8,814.7	8,704.8	8,636.6	8,718.7
Total Mercury Mass Rates				
lb/hr input in coal	0.058	0.062	0.061	0.060
lb/hr at FGD inlet	0.032	0.066	0.061	0.053
lb/hr emitted	0.058	0.069	0.013	0.047

N.D. – None Detected.

Table 3-5
Colstrip Unit Number 3 Process Data

Run Number	1	2	3
Test Date	09/29/99	09/29/99	09/30/99
Test Time	0830-1220	1330-1603	0815-1049
Unit Operation			
Unit Load - MW net	746	744	748
Steam Flow – mlbs/hr	5.913	5.932	5.928
Coal Mills in Service	A, C, D, E, F, G, H	A, C, D, E, F, G, H	A, C, D, E, F, G, H
Coal Flow – klbs/hr	923	936	912
CEMS data			
NO_x - ppm	240.4	233.9	247.0
SO_2 - ppm	36.33	45.47	35.06
CO_2 - %	11.93	12.00	11.95
Opacity - %	15.7	14.9	17.6
Stack Flow – kscfm	2,047.2	2,035.4	2,040.6
Stack Temperature - °F	189.9	192.5	191.9
FGD data			
SO_2 at outlet- ppm	64.70	42.01	11.33
Gas inlet temperature - °F	283	288	269
Gas outlet temperature - °F	131	131	130

4 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Emission Test Methods

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, 17, and 19; in the Ontario Hydro Method, Revised July 7, 1999, and ASTM Methods D2234, D6414-99, D2361-95, D-0516, D-3174, and D-3286.

A preliminary velocity traverse was made at each of the two ports on the Unit Number 3-6 Scrubber Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points were checked for cyclonic flow and the average angle was equal to 3.4 degrees. Alternate procedures would be required if the angle of cyclonic flow was greater than 20 degrees. Twelve traverse points were sampled from each of the two ports for a total of twenty-four traverse points.

A preliminary velocity traverse was made at each of the four ports on the Unit Number 3 Stack, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points were checked for cyclonic flow and the average angle was equal to 3.5 degrees. Alternate procedures would be required if the angle of cyclonic flow were greater than 20 degrees. Six traverse points were sampled from each of the four ports for a total of twenty-four traverse points.

The sampling trains were leak-checked at the end of the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during each test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

Integrated orsat samples were collected and analyzed according to EPA Method 3B during each test.

4.1.1 Mercury

Triplicate samples for mercury were collected. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5 and 17; and the Ontario Hydro Method, Revised July 7, 1999. For each run, samples of five-minute duration were taken isokinetically at each of the twenty-four traverse points at each of the sampling locations for a total sampling time of 120 minutes. Data was recorded at five-minute intervals. Reagent blanks and field blanks were submitted.

The "front-half" of the sampling train at the inlet sampling location contained the following components:

Teflon Coated Nozzle
In-stack Quartz Fiber Thimble and Backup Filter and Teflon Coated Support
Heated Glass Probe @ > 248°F

The "front-half" of the sampling train at the stack sampling location contained the following components:

Teflon Coated Nozzle
Heated Glass Probe @ > 248°F
Heated Quartz Fiber Filter and Teflon Support @ > 248°F

The "back-half" of the sampling train at both sampling locations contained the following components:

Impinger Number	Impinger Type	Impinger Contents	Amount	Parameter Collected
1	Modified Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
2	Modified Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
3	Greenburg-Smith Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
4	Modified Design	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury and Moisture
5	Modified Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
6	Modified Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
7	Greenburg-Smith Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
8	Modified Design	Silica	200 g	Moisture

All glassware was cleaned prior to use according to the guidelines outlined in EPA Method 29, Section 5.1.1 and the Ontario Hydro Method, Revised July 7, 1999, Section 13.2.15. All glassware connections were sealed with Teflon tape.

At the conclusion of each test, the filter and impinger contents were recovered according to procedures outlined in the Ontario Hydro Method, Revised July 7, 1999, Section 13.2.

Mercury samples were analyzed by Cold Vapor Atomic Absorption and Fluorescence Spectroscopy.

4.2 Process Test Methods

ASTM D2234 method of coal sampling was followed. For each test run, a grab sample of coal was collected from each coal feeder immediately upstream of the coal pulverizers. One composite sample was prepared for analysis from the individual feeder samples. Each sample was analyzed for mercury, chlorine, sulfur, ash, and Btu content by ASTM Methods D6414-99, D2361-95, D-0516, D-3174, and D-3286, respectively.

4.3 Sample Tracking and Custody

Samples and reagents were maintained in limited access, locked storage at all times prior to the test dates. While on site, they were at an attended location or in an area with limited access. Off site, METCO and TestAmerica provided limited access, locked storage areas for maintaining custody.

Chain of custody forms are located in Appendix F. The chain of custody forms will provide a detailed record of custody during sampling, with the initials noted of the individuals who load and recover impingers and filters and perform probe rinses.

All samples were packed and shipped in accordance with regulations for hazardous substances.

5 QA/QC ACTIVITIES

The major project quality control checks are listed in Table 5-1. Matrix Spike Summaries are listed in Table 5-2. Duplicate and Triplicate Analyses Summaries are listed in Table 5-3. Additional method-specific QC checks are presented in Table 5-4 (Methods 1 and 2), Table 5-5 (Method 5/17 sampling), and Table 5-6 (Ontario Hydro sample recovery and analysis). These tables also include calibration frequency and specifications.

Table 5-1 Major Project Quality Control Checks

QC Check	*Information Provided*	*Results*
Blanks		
Reagent blank	Bias from contaminated reagent	No Mercury was detected
Field blank	Bias from handling and glassware	No Mercury was detected
Spikes		
Matrix spike	Analytical bias	Sample results were between 75% - 125% recovery
Replicates		
Duplicate analyses	Analytical precision	Results were < 10% RPD
Triplicate analyses	Analytical precision	Results were < 10% RPD

Table 5-2 Unit Number 3 Matrix Spike Summary

Sampling Location	*Run Number*	*Container*	*Results (ug/L)*	*True Value (ug/L)*	*Recover (%)*
Inlet Duct	2	3	0.88	1.0	88
Inlet Duct	1	1B	0.96	1.0	96

Table 5-3
Unit Number 3 Duplicate and Triplicate Analyses Summary

Sampling Location	Run Number	Container	Results (ug)	Duplicate Results (ug)	RPD	Triplicate Results (ug)	RPD
Inlet Duct (Scrubber 3-6)	1	1A	2.41	2.47	2.3	2.50	3.4
		1B	<0.01	<0.01	0	—	—
		2	<0.220	<0.220	0	—	—
		3	3.10	3.02	2.4	3.03	2.1
		4	<0.600	<0.600	0	—	—
		5	1.45	1.45	0.3	—	—
	2	1A	2.65	2.65	0	—	—
		1B	0.011	0.011	0	—	—
		2	<0.130	<0.130	0	—	—
		3	3.24	3.21	0.9	—	—
		4	<0.600	<0.600	0	—	—
		5	8.70	8.66	0.6	—	—
	3	1A	2.25	2.25	0	—	—
		1B	0.030	0.030	0	—	—
		2	<0.130	<0.130	0	—	—
		3	3.98	3.98	0	—	—
		4	<0.80	<0.80	0	—	—
		5	7.52	7.32	2.7	—	—
Stack	1	1A	0.090	0.090	0.6	—	—
		2	<0.310	<0.310	0	—	—
		3	<1.48	<1.48	0	—	—
		4	<0.66	<0.66	0	—	—
		5	16.20	16.30	0.8	—	—
	2	1A	0.05	0.05	0	—	—
		2	<0.390	<0.390	0	—	—
		3	<1.64	<1.64	0	—	—
		4	<0.740	<0.740	0	—	—
		5	19.9	19.9	0	—	—
	3	1A	0.040	0.040	0	—	—
		2	<0.270	<0.270	0	—	—
		3	<1.52	<1.52	0	—	—
		4	<0.660	<0.660	0	—	—
		5	4.15	4.12	0.6	—	—

Table 5-4
QC Checklist and Limits for Methods 1 and 2

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Measurement site evaluation	>2 diameters downstream and 0.5 diameters upstream of disturbances	Method 1, Section 2.1
Pitot tube inspection	Inspect each use for damage, once per program for design tolerances	Method 2, Figures 2-2 and 2-3
Thermocouple	+/- 1.5% (°R) of ASTM thermometer, before and after each test mobilization	Method 2, Section 4.3
Barometer	Calibrate each program vs. mercury barometer or vs. weather station with altitude correction	Method 2, Section 4.4

Table 5-5
QC Checklist and Limits for Method 5/17 Sampling

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Pre-mobilization checks		
Gas meter/orifice check	Before test series, Y_D +/- 5% (of original Y_D)	Method 5, Section 5.3
Probe heating system	Continuity and resistance check on element	
Nozzles	Note number, size, material	
Glassware	Inspect for cleanliness, compatibility	
Thermocouples	Same as Method 2	
On-site pre-test checks		
Nozzle	Measure inner diameter before first run	Method 5, Section 5.1
Probe heater	Confirm ability to reach temperature	
Pitot tube leak check	No leakage	Method 2, Section 3.1
Visible inspection of train	Confirm cleanliness, proper assembly	
Sample train leak check	≤0.02 cf at 15" Hg vacuum	Method 5, Section 4.1.4
During testing		
Probe and filter temperature	Monitor and confirm proper operation	
Manometer	Check level and zero periodically	
Nozzle	Inspect for damage or contamination after each traverse	Method 5, Section 5.1
Probe/nozzle orientation	Confirm at each point	
Post test checks		
Sample train leak check	≤0.02 cf at highest vacuum achieved during test	Method 5, Section 4.1.4
Pitot tube leak check	No leakage	Method 2, Section 3.1
Isokinetic ratio	Calculate, must be 90-110%	Method 5, Section 6
Dry gas meter calibration check	After test series, Y_D +/- 5%	Method 5, Section 5.3
Thermocouples	Same as Method 2	
Barometer	Compare w/ standard, +/- 0.1" Hg	

Table 5-6 QC Checklist and Limits for Ontario Hydro Mercury Speciation

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Pre-mobilization activities		
Reagent grade	ACS reagent grade	Ontario Hydro Section 8.1
Water purity	ASTM Type II, Specification D 1193	Ontario Hydro Section 8.2
Sample filters	Quartz; analyze blank for Hg before test	Ontario Hydro Section 8.4.3
Glassware cleaning	As described in Method	Ontario Hydro Section 8.10
On-site pre-test activities		
Determine SO_2 concentration	If >2500 ppm, add more HNO_3-H_2O_2 solution	Ontario Hydro Section 13.1.13
Prepare KCl solution	Prepare batch as needed	Ontario Hydro Section 8.5
Prepare HNO_3-H_2O_2 solution	Prepare batch as needed	Ontario Hydro Section 8.5
Prepare H_2SO_4-$KMnO_4$ solution	Prepare daily	Ontario Hydro Section 8.5
Prepare HNO_3 rinse solution	Prepare batch as needed; can be purchased premixed	Ontario Hydro Section 8.6
Prepare hydroxylamine solution	Prepare batch as needed	Ontario Hydro Section 8.6
Sample recovery activities		
Brushes and recovery materials	No metallic material allowed	Ontario Hydro Section 13.2.6
Check for $KMnO_4$ Depletion	If purple color lost in first two impingers, repeat test with more HNO_3-H_2O_2 solution	Ontario Hydro Section 13.1.13
Probe cleaning	Move probe to clean area before cleaning	Ontario Hydro Section 13.2.1
Impinger 1,2,3 recovery.	After rinsing, add permanganate until purple color remains to assure Hg retention	Ontario Hydro Section 13.2.8
Impinger 5,6,7 recovery.	If deposits remain after HNO_3 rinse, rinse with hydroxylamine sulfate. If purple color disappears after hydroxylamine sulfate rinse, add more permangante until color returns	Ontario Hydro Section 13.2.10
Impinger 8	Note color of silica gel; if spent, regenerate or dispose.	Ontario Hydro Section 13.2.11
Blank samples		
0.1 N HNO_3 rinse solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
KCl solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
HNO_3-H_2O_2 solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
H_2SO_4-$KMnO_4$ solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
Hydroxylamine sulfate solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
Unused filters	Three from same lot.	Ontario Hydro Section 13.2.12
Field blanks	One per set of tests at each test location.	Ontario Hydro Section 13.4.1
Laboratory activities		
Assess reagent blank levels	Target <10% of sample value or <10x instrument detection limit. Subtract as allowed.	Ontario Hydro Section 13.4.1
Assess field blank levels	Compare to sample results. If greater than reagent blanks or greater than 30% of sample values, investigate. Subtraction of field blanks not allowed.	Ontario Hydro Section 13.4.1
Duplicate/triplicate samples	All CVAAS runs in duplicate; every tenth run in triplicate. All samples must be within 10% of each other; if not, recalibrate and reanalyze.	Ontario Hydro Section 13.4.1

6 DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 11:30 a.m. on Tuesday, September 28, 1999. After meeting with plant personnel and attending a brief safety meeting, the equipment was moved onto the Unit Number 3-6 Scrubber Inlet Duct and Unit Number 3 Stack. The preliminary data was collected. The equipment was secured for the night. All work was completed at 6:30 p.m.

On Wednesday, September 29, work began at 6:30 a.m. The equipment was prepared for testing. Testing was delayed due to reference method equipment problems. The first set of tests for mercury began at 8:30 a.m. Testing continued until the completion of the second set of tests at 4:03 p.m. The samples were recovered. The equipment was secured for the night. All work was completed at 6:30 p.m.

On Thursday, September 30, work began at 6:30 a.m. The equipment was prepared for testing. The third set of tests for mercury began at 8:15 a.m. and was completed at 10:49 a.m.

The samples were recovered. The equipment was moved off of the sampling locations and loaded into the sampling van. The samples and the data were transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operation at Montana Power Company, Colstrip Project Division, Unit Number 3-6 Scrubber Inlet Duct and Unit Number 3 Stack, located in Colstrip, Montana, were completed at 2:00 p.m. on Thursday, September 30, 1999.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr. P.E.
President